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Title	:	PARTICLE EXTRACTION FOR AUTOMATIC FLOW MICROSCOPE
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APPEAL BRIEF

Sir:

This is a brief for an appeal from a Final Office Action dated April 27, 2009, and from a Notice of Appeal mailed on July 27, 2009.

1. Real Party in Interest

The real party of interest is IRIS Remote Imaging Systems, Inc. of Chatsworth, CA, pursuant to the assignment executed on March 9, 2004, recorded on March 22, 2004 at reel/frame 015111/0615. IRIS Remote Imaging Systems, Inc. has since changed its name to IRIS International, Inc.

2. Related Appeals and Interferences

There are no related appeals or interferences.

3. Status of Claims

Claims 1-38 were originally presented on the filing of the present application. Claim 20 was amended in a response filed August 23, 2007, and claims 1-2 were amended in a response filed January 23, 2009. This is an appeal of the rejected claims 1-38. No other claims are pending or have been cancelled.

4. Status of Amendments

No amendments have been filed subsequent to the Final Office Action of April 27, 2009.

5. Summary of the Claimed Subject Matter

Claim 1

The invention claimed in independent claim 1 is a method for automatically locating a boundary of an object of interest in a field of view (Abstract; Specification, p. 1, lines 25-27). This method involves forming an electronic image of the field of view containing the object using an imaging system, wherein the electronic image is formed of a plurality of image pixels (Specification, p. 5, line 15-p. 6 line 2.).

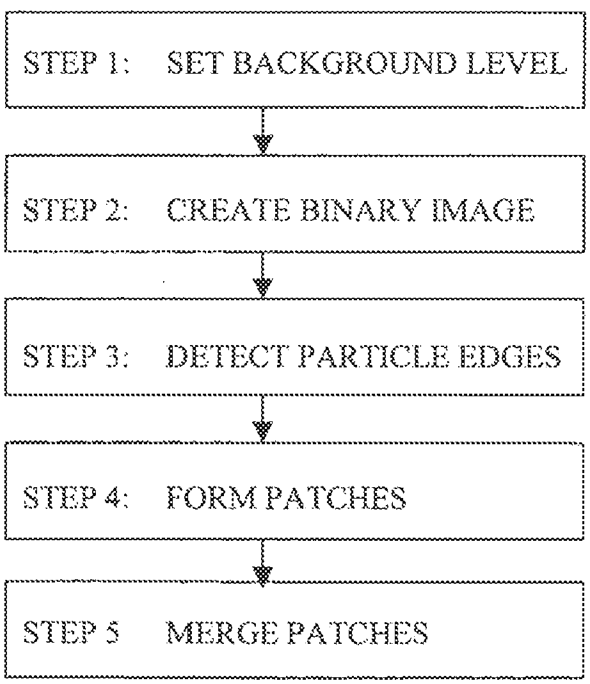

FIG. 2

An example of a binary electronic image of the field of view containing the object that is formed of a plurality of image pixels is shown in Figure 5.

```
0000000000000000000000000000000000000000
0000000000000000001110000000000000000000
0000000000000000000000000000000000000000
0000000000000000111111000000000000000000
0000000000000011111111111000000000000000
0000000000011111111111111111110000000000
0000001111111111111111111111110000000000
0000001111111111111111111111111111111000
0000111111111111111111111111111111110000
0000000000111111111111111111111111110000
0000111111111111111111111111111101110000
0000001111111111111111111111010010011000
0000000011111111111111111111111110000000
0000000111111111111111111111111111000000
0000000001111111111111111111111110000000
0000000000001111111111111001100000000000
0000000000000001111111111100000000000000
0000000000000000000001011101000000000000
0000000000000000000000111100000000000000
0000000000000000000000000000000000000000
```

FIG. 5

Groups of the image pixels are identified that represent edge segments of the object using at least one processor (Specification, p. 6, line 21- p. 7, line 7). Figure 6 shows the identified edge segments of the object in Figure 5.

```
0000000000000000000000000000000000000000
0000000000000000001110000000000000000000
0000000000000000000000000000000000000000
0000000000000000111111000000000000000000
0000000000000011100000111100000000000000
0000000000011110000000001111110000000000
0000001111110000000000000000000000000000
0000001000000000000000000000000000011000
0000111000000000000000000000000000010000
0000000000000000000000000000000000010000
0000111000000000000000000000000000010000
0000001110000000000000000000000010011000
0000000010000000000000000000001110000000
0000000111000000000000000000000011000000
0000000001111000000000000000001110000000
0000000000001111000000000001100000000000
0000000000000001111111100010000000000000
0000000000000000000001011001000000000000
0000000000000000000000111100000000000000
0000000000000000000000000000000000000000
```

FIG. 6

Patches are formed around the edge segments (in image pixel groups), where each patch is dimensioned and positioned to entirely contain one of the edge segments (Specification, p. 7, lines 10-25). Figure 7 shows the patches P1, P2, P3 and P4 formed around the edge segments of Figure 6.

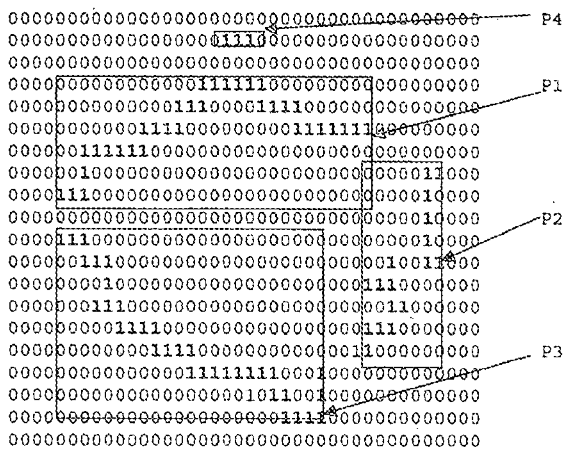

FIG. 7

A patch merge process is then performed that merges any two of the patches together that meet a predetermined proximity threshold relative to each other to form a merged patch that is dimensioned and positioned to entirely contain the two merged patches (Specification, p. 7, line 28- p. 8, line 4). Figure 8A shows an image where the patches of Figure 7 have undergone a first patch merge process, such that patches P1 and P2 have been merged into patch P5.

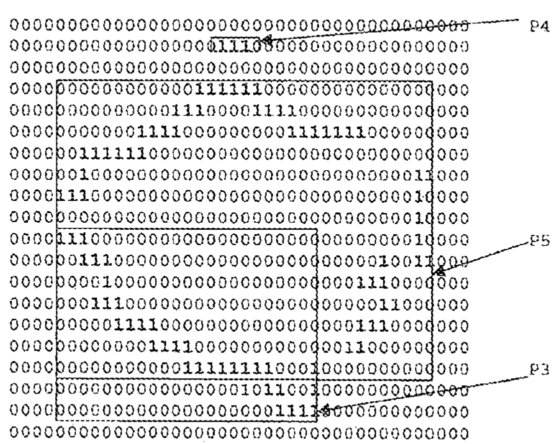

FIG. 8A

The merge process continues iteratively for any of the patches and the merged patches meeting the predetermined proximity threshold until none of the remaining patches and merged patches meet the predetermined proximity threshold (Specification, p. 8, lines 4-6). Figures 8B and 8C show this continuing merge process, where patches P5 and P3 of Figure 8A are merged into patch P6 in Figure 8B, and patches P4 and P6 from Figure 8B are merged into patch P7 in Figure 8C, at which point there are no patches or merged patches left that meet the proximity threshold.

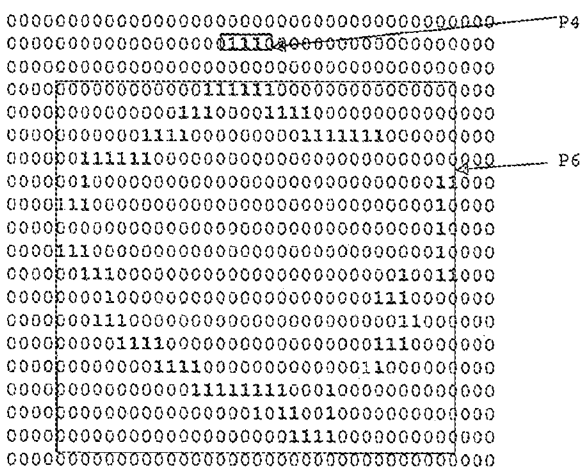

FIG. 8B

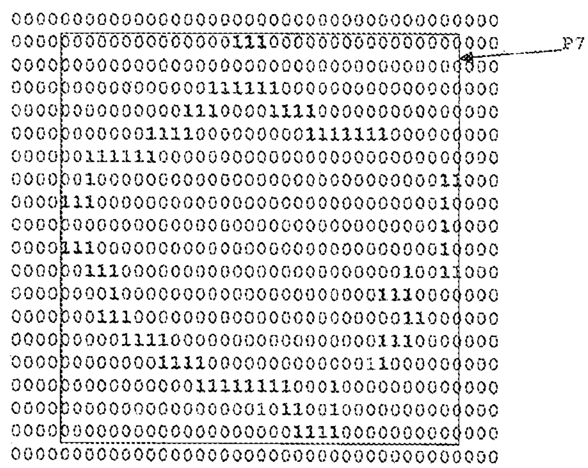

FIG. 8C

Once patch merging is complete, those edge segments found within one of the final patches are associated with a single particle (as representing the boundary of that single particle), and any edge segment(s) found outside of that final patch are associated as either non-particles or part of an adjacent but distinct particle (specification, p. 8, lines 20-23).

Claim 20

Claim 20 is directed to an apparatus for automatically locating a boundary of an object of interest in a field of view (Specification, p. 2, lines 6-16).

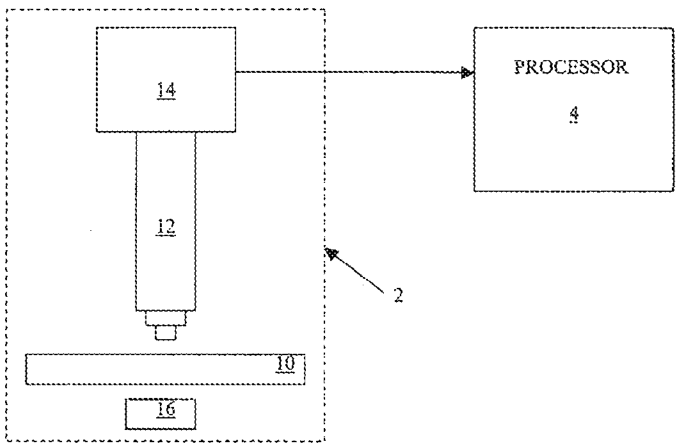

FIG. 1

This apparatus includes an imaging system, shown as block 2 in Figure 1, for forming an electrical image of the field of view containing the object (Specification, p. 3, lines 11-12), wherein the electronic image is formed of a plurality of image pixels (Specification, p. 3, lines 20-21).

The apparatus also includes at least one processor (Specification, p. 3, lines 25-30), shown as block 4 in Figure 1. The processor serves several purposes. The processor is for identifying groups of the image pixels that represent edge segments of the object (Specification, p. 6, line 21- p. 7, line 7; Fig. 6), and forming patches around the edge segments (in image pixel groups) where each patch is dimensioned and positioned to entirely contain one of the edge segments (Specification, p. 7, lines 10-25; Fig. 7).

The processor is also for performing a patch merge process (Specification, p. 3, lines 26-27). The patch merge process merges any two of the patches together that meet a predetermined proximity threshold relative to each other. The resulting merged patch is dimensioned and positioned to entirely contain the two patches being merged (Specification, p. 7, line 28- p. 8, line 4; Fig. 8A). The merge process then continues for any of the patches and merged patches meeting the predetermined proximity threshold until none of the patches and the merged patches meet the predetermined proximity threshold (Specification, p. 8, lines 4-6; Figs. 8B-8C). Once

patch merging is complete, those edge segments found within one of the final patches are associated with a single particle (Specification, p. 8, lines 20-23).

6. Grounds Of Rejection To Be Reviewed On Appeal

The sole issue on appeal is whether claims 1-38 are unpatentable under 35 U.S.C. §103 over U.S. Patent No. 4,538,299 (hereinafter "DeForest") in view of U.S. Patent Publication 2002/0031255A1 (hereinafter "Kasdan").

7. Argument

Claims 1-38 stand rejected under 35 U.S.C. 103(a) as being unpatentable over DeForest in view of Kasdan. The Applicant respectfully traverses this rejection.

Prior art DeForest

DeForest discloses an apparatus and method for automatically locating the boundary of an object in a field of view with a raster scan device in order to generate an electrical image of a field of view (See Abstract; Col. 1, lines 55-56). The image is segmented into pixels with digitized image intensity. Derivative representations are then formed of the image by modifying the value for each pixel with the values of the nearest adjacent neighbors (Col. 1, line 58- Col. 2 line 3). The various possible values for a pixel modified by the nearest adjacent neighbors are stored in a table, where the table receives a pixel value and an input direction, and outputs a direction value to indicate a next location of a pixel with a non zero value. It is the non-zero value pixels that form the object boundary (Col. 2, lines 4-9).

Prior art Kasdan

Kasdan discloses a multi-neural net imaging apparatus and method for classification of image elements, such as biological particles (see Abstract). As part of that process, the system analyzes the images of successive fields, and isolates the particles in individual patches using a

conventional patch extraction apparatus (paragraph [0043]). That apparatus defines local areas (patches) containing particles of interest. The boundary of each particle is identified and defined, and used to extract the picture data for each particle from the larger field, thereby producing digital patch images that each contain the image of an individual particle of interest (paragraph [0043]). The system uses a threshold routine to detect the edges (of the particle), by defining as edges the locations where the intensity crosses a predetermined threshold (paragraph [0047]). The detected edges are connected together to result in an edges image, which contains lines that correspond to detected boundaries that outline the various particles (paragraph [0047]). Once the image of the particle has been localized within the patch image, and its boundary further refined by creating a white mask image of the particle, the patch and mask images are further processed to extract particle features from the particle image (paragraph [0050]). Families of particle features for extraction include shape (paragraphs [0051]+), symmetry (paragraphs [0056]+), skeletonization (paragraphs [0065]+), radii values (paragraphs [0072]+), intensity (paragraphs [0080]+), Fourier Transform (paragraphs [0083]+), grayscale and color histogram quantiles of image intensities (paragraphs [0135]+), concentric circles and annuli (paragraphs [00161]+), and concentric squares (paragraphs [0177]+).

The Examiner Has Not Established Prima Facie Obviousness

To support an obviousness rejection, MPEP §2143.03 requires "all words of a claim to be considered" and MPEP § 2141.02 requires consideration of the "[claimed] invention and prior art as a whole." Further, the Board of Patent Appeal and Interferences recently confirmed that a proper, post ‑ KSR obviousness determination still requires the Office make "a searching comparison of the claimed invention – *including all its limitations* – with the teaching of the prior art" and "obviousness requires a suggestion of all limitations in a claim." *In re Wada and Murphy*, Bd. Pat. App. & Inter. 2008, Appeal 2007 ‑ 3733, page 7, citing *In re Ochiai*, 71 F.3d 1565, 1572 (Fed. Cir. 1995) and *CFMT v. Yieldup Intern. Corp.*, 349 F.3d 1333, 1342 (Fed. Cir. 2003). In sum, it remains well settled law that an obviousness rejection requires at least a

suggestion of all of the claim elements. As established below, there are elements in the rejected claims that are not found in either of the prior art references relied upon by the Examiner in rejecting the claims.

Claims 1 and 20

Independent claims 1 and 20 recite a system and method for locating a boundary of an object by:

1) forming an image of the object,

2) identify groups of the image pixels that represent edge segments of the object,

3) form patches around the image pixel groups that are each dimensioned and positioned to entirely contain one of the image pixel groups,

4) performing a patch merge process that merges any two of the patches together that meet a predetermined proximity threshold relative to each other to form a merged patch that is dimensioned and positioned to entirely contain the two merged patches, and

5) continuing the merge process for any of the patches and the merged patches meeting the predetermined proximity threshold until none of the patches and the merged patches meet the predetermined proximity threshold.

This technique more reliably groups together edge segments representing the boundary of a single particle, without unnecessarily including edge segments that are either non-particles or should be associated with another particle, thus allowing any gaps between edge segments from a single particle to be filled in to form a single and continuous particle edge (see specification page 8, lines 20-25).

The Examiner acknowledges on page 4 of the Final Office Action that DeForest fails to disclose the patch formation and merge of claims 1 and 20. The Examiner states, however, that Kasdan discloses the claimed patch formation and merge of claims 1 and 20 (citing to paragraphs 0043, 0047, 0048 and 0050), and that it would have been obvious to use the Kasdan patch

formation/merge in DeForest's automatic location of the object boundary. The Applicant respectfully traverses these statements and conclusions.

Kasdan discloses a multi-neural net imaging apparatus and method for classification of image elements, such as biological particles (see Abstract). As part of that process, the system isolates the particles in successive fields of images (see paragraph [0043]). While Kasdan contemplates using a patch extraction apparatus to define local areas (patches) containing particles of interest whereby the boundary of each particle is identified and defined (see paragraph [0043]), Kasdan does not contemplate or suggest doing so by merging patches using a proximity threshold, let alone continuing the merge of patches and merged patches until none of them meet the proximity threshold, as recited in claims 1 and 20. Kasdan does contemplate using a threshold routine to detect edges. However, this threshold routine compares pixel intensity values to a threshold (see paragraph [0047]). Applying an intensity threshold to pixel values is distinguishable from (i.e. does not teach or suggest) using a proximity threshold on patches.

On page 4 of the Final Office Action, the Examiner states that Kasdan teaches the claimed patch formation with patches dimensioned and positioned to entirely contain one of the image pixel groups, citing the following text from Kasdan:

- Paragraph [0043]:

  produced by the imaging system and to define local areas (patches) containing particles of interest. The boundary of each particle is identified and defined, and used to extract the picture data for each particle from the larger field, thereby

To the contrary, all that this cited language discloses is the concept that patches are used to define local areas containing particles of interest. There is no suggestion of using patches to define edge segments, as opposed to simply using each patch to define an entire particle of interest.

On page 5 of the Final Office Action, the Examiner states several sections of Kasdan teach the claimed patch merge process, which the Applicant respectfully traverses as follows:

- Paragraph [0043]:

> produced by the imaging system and to define local areas (patches) containing particles of interest. The boundary of each particle is identified and defined, and used to extract the picture data for each particle from the larger field, thereby producing digital patch images that each contain the image of an individual particle of interest (resulting in a significant compression of the data subsequently required for processing). Imaging system **2** and first processor **4** combine to perform the first step (collection of individual images) shown in **FIG. 1**.

This text merely discloses that the extraction apparatus is used to define local areas (i.e. patches) containing the particle of interest. There simply is no disclosure or suggestion that patches are merged, let alone that the extraction apparatus uses a proximity threshold to perform the patch merge.

- Paragraph [0047]:

> followed by a gradient image. A threshold routine is used to detect the edges, whereby the locations where the intensity crosses a predetermined threshold are defined as edges. The detected edges are connected together to result in an edges image **16**, which contains lines that correspond to detected boundaries that outline the various particles.

This text merely discloses a threshold routine where the intensity levels associated with the pixels forming the image are analyzed, and edges are determined to be at those locations where the intensity levels cross a predetermined threshold. It is respectfully submitted that applying a pixel <u>**intensity** threshold</u> to individual pixel intensity values (for the purposes of identifying which pixels represent the particle edge) does not teach or suggest applying a <u>**proximity** threshold</u> to adjacent patches (for the purposes of merging proximate patches together).

On page 5 of the Office Action, the Examiner states the following section of Kasdan allegedly teaches continuing the merging process until none of the patches and the merged patches meet the predetermined proximity threshold:

- Paragraph [0047]:

> followed by a gradient image. A threshold routine is used to detect the edges, whereby the locations where the intensity crosses a predetermined threshold are defined as edges. The

This text merely discloses an **intensity threshold** to pixel values, not a **proximity threshold** to patches, let alone the continuation of the patch merge process until none of them meet the proximity threshold as recited in claims 1 and 20.

Because neither cited reference teaches or suggests the claimed patch formation and merge, it is respectfully submitted that claims 1 and 20 are not rendered obvious by DeForest in view of Kasdan, and that the Board should reverse this rejection.

With respect to claims 2-19 and 21-38, these claims depend from claims 1 or 20, and are therefore considered allowable for the reasons set forth above. Moreover, because neither DeForest or Kasdan teach or suggest the claimed general patch formation and merge as recited in independent claims 1 or 20, they certainly do not teach or suggest the particular and more specific features of the patch formation and merge as recited in these dependent claims, as set forth below.

Claims 2 and 21

On page 6 of the Final Office Action, the Examiner maintains that claims 2 and 21 are unpatentable over DeForest in view of Kasdan.

Claims 2 and 21 recite the step of, or at least one processor for, associating all the edge segments contained within one of the merged patches as representing the boundary of the object. DeForest discloses no similar recitation. The Examiner relies on paragraphs [0043] and [0048] of Kasdan to support this rejection. However, Kasdan merely discloses forming a mask image

where the boundary lines are white and the background is black, and small gaps in the boundary lines are filled to connect some of the boundary lines together. Inverting the image and filling in edge gaps does not teach or suggest **associating** all the edge segments in one of the **merged** patches as representing the boundary.

Thus it is respectfully submitted that claims 2 and 21 are not rendered obvious over DeForest in view of Kasdan.

Claims 3 and 22

On page 6 of the Final Office Action, the Examiner maintains that claims 3 and 22 are unpatentable over DeForest in view of Kasdan.

Claims 3 and 22 recite that the predetermined proximity threshold is a predetermined number of the image pixels shared by any of the patches and merged patches that overlap each other. The Examiner relies upon paragraphs [0043] and [0048] of Kasdan for this rejection. However, as noted by the Examiner, these paragraphs of Kasdan merely disclose collecting individual images, creating an inverted mask image so boundary lines are white and the background is black, cleaning small specks and particles too small to be of interest, and filling gaps in the boundary lines to connect some of the boundary lines together. Kasdan does not contemplate the claimed patch merge process, let alone doing so based upon a predetermined number of image pixels shared by any of the patches and merged patches that overlap each other as recited in claims 3 and 22.

Thus it is respectfully submitted that claims 3 and 22 are not rendered obvious over DeForest in view of Kasdan.

Claims 4-9 and 23-28

On pages 6-9 of the Final Office Action, the Examiner maintains that claims 4-9 and 23-28 are unpatentable over DeForest in view of the same cited paragraphs ([0047] and [0048]) of Kasdan.

The Examiner relies on paragraph [0047] for disclosing the use of a threshold routine to detect the edges, whereby locations where the intensity crosses a predetermined threshold are defined as edges, and on paragraph [0048] for disclosing the creation of a mask image from the detected edge, the inversion of the edge image so boundary lines are white and the background is black, the cleaning of the image of small specks and particles too small to be of interest, and the filling of small gaps in the boundary lines to connect some of boundary lines together.

In contrast, claims 4 and 23 recite that the predetermined distance (for merging proximate patches) is measured from boundaries of the patches and merged patches. It is submitted that edge detection, mask image creation and inversion, image cleaning, and gap filling does not teach or suggest merging patches meeting a proximity threshold as recited in claim 1, let alone one using a predetermined distance measured from boundaries of the patches and merged patches as recited in claims 4 and 23.

Claims 5 and 24 recite that the predetermined proximity threshold is a predetermined distance between any of the patches and merged patches. It is submitted that edge detection, mask image creation and inversion, image cleaning, and gap filling does not teach or suggest merging patches meeting a proximity threshold as recited in claim 1, let alone one which is a predetermined distance between any of the patches and merged patches as recited in claims 5 and 24.

Claims 6 and 25 recite that the predetermined distance is measured from center portions of the patches and merged patches. It is submitted that edge detection, mask image creation and inversion, image cleaning, and gap filling does not teach or suggest merging patches meeting a proximity threshold as recited in claim 1, let alone one using a predetermined distance measured from center portions of the patches and merged patches as recited in claims 6 and 25.

Claims 7 and 26 recite that the predetermined proximity threshold is calculated from the sizes and separation distances of the patches and merged patches. It is submitted that edge detection, mask image creation and inversion, image cleaning, and gap filling does not teach or suggest merging patches meeting a proximity threshold as recited in claim 1, let alone one which

is calculated from the sizes and separation distances of the patches and merged patches as recited in claims 7 and 26.

Claims 8 and 27 recite that the forming of the patches further comprises dimensioning each of the patches as small as possible while still entirely containing one of the image pixel groups. It is submitted that edge detection, mask image creation and inversion, image cleaning, and gap filling does not teach or suggest merging patches meeting a proximity threshold as recited in claim 1, let alone dimensioning each of the patches as small as possible while still entirely containing one of the image pixel groups as recited in claims 8 and 27.

Claims 9 and 28 recite that after the dimensioning of the patches as small as possible, the forming of the patches further comprises expanding each of the patches by moving wall portions of the patch away from a center of the patch by a predetermined distance. It is submitted that edge detection, mask image creation and inversion, image cleaning, and gap filling does not teach or suggest merging patches meeting a proximity threshold as recited in claim 1, let alone expanding each of the patches by moving wall portions of the patch away from a center of the patch by a predetermined distance after the dimensioning of the patches as small as possible as recited in claims 9 and 28.

For these reasons, it is respectfully submitted that claims 4-9 and 23-28 are not rendered obvious over DeForest in view of Kasdan.

Claims 10 and 29

On page 9 of the Final Office Action, the Examiner maintains that claims 10 and 29 are unpatentable over DeForest in view of Kasdan.

Claims 10 and 29 recite that each of the patches has a rectangular shape. The Examiner relies upon paragraph [0043] of Kasdan for this rejection, which discloses defining local areas (patches) containing particles of interest, where the boundary of each particle is identified and defined, and used to extract picture data for each particle from a larger field, thereby producing digital patch images containing the image of individual particles of interest. It is submitted that

these disclosures of Kasdan (local patches, boundary identification, and picture data extraction) do not teach or suggest using rectangular shaped patches (for the claimed patch merge), especially given that particles are not rectangularly shaped.

Thus it is respectfully submitted that claims 10 and 29 are not rendered obvious over DeForest in view of Kasdan.

Claims 11 and 30

On pages 9-11 of the Final Office Action, the Examiner maintains that claims 11 and 30 are unpatentable over DeForest in view of Kasdan.

Claims 11 and 30 recite that the groups of image pixels that represent edge segments of the object are identified by forming a background level image of the field of view, wherein the background level image is formed of a plurality of background level pixels each corresponding in location to one of the image pixels and each having a pixel value. The Examiner states that this is disclosed in paragraph [0046] of Kasdan, which discloses further refining the particle boundary by creating black and white mask images of the particles (so that pixels outside the boundary – background pixels – are black, and pixels inside the particle boundary are white). It is submitted that refining the particle boundary by creating black and white mask images, let alone where only the pixels outside the boundary are considered background pixels) does not teach or suggest forming a background level image of the field of view as claimed.

Claims 11 and 30 further recite classifying as an object pixel each of the image pixels having a pixel value that varies by at least a predetermined amount from the pixel value of the corresponding background level pixel. The Examiner states that this is disclosed in paragraph [0010] of Kasdan, which discloses a method classifying an element in an image by extracting features from the image, determining a classification class of the element, and modifying the class based upon previously determined classification class determinations. It is submitted that image feature extraction, class determination, and class determination modification, do not teach

or suggest the classification of object pixels should their values vary by at least a predetermined amount from the corresponding background level pixel as claimed.

Thus it is respectfully submitted that claims 11 and 30 are not rendered obvious over DeForest in view of Kasdan.

Claims 12 and 31

On pages 11-12 of the Final Office Action, the Examiner maintains that claims 12 and 31 are unpatentable over DeForest in view of Kasdan.

Claims 12 and 31 recite that the system forms the background level image of the field of view by forming N background electronic images of the field of view not containing any objects of interest, wherein each of the background electronic images is formed of a plurality of background pixels each corresponding in location to one of the background level pixels and each having a pixel value (where N is a positive integer). The Examiner states that this is disclosed in paragraph [0046] of Kasdan, which discloses creating black and white mask images of the particles (so that pixels outside the boundary – background pixels – are black, and pixels inside the particle boundary are white). It is submitted that making a mask image where pixels inside the boundary are white and pixels outside the boundary are black does not teach or suggest creating a background electronic image <u>of the field of view</u>, as claimed.

Claims 12 and 31 further recite generating each one of the background level pixels by calculating a median value of the pixel values for the background pixels corresponding to the one background level pixel. Here, the Examiner relies on paragraph [0071] of Kasdan, which describes a technique for measuring the shape of a particle using radial lengths of radii that fit in the particle, and the quantile rankings of those values. Not only does this paragraph of Kasdan fail to contemplate generating background level pixels by calculating median values of the pixel values, but this rejection contradicts the Examiner's rejection above with respect to the formation of the background level image in the first place (which according to the Examiner corresponds to the generation of black and white mask images). If background level pixels are made to be either

black or white, then there would be no apparent need to calculate median values of pixel values to generate the background level image.

Thus it is respectfully submitted that claims 12 and 31 are not rendered obvious over DeForest in view of Kasdan.

<u>Claims 13 and 32</u>

On page 12 of the Final Office Action, the Examiner maintains that claims 13 and 32 are unpatentable over DeForest in view of Kasdan.

Claims 13 and 32 recite that the system flows transparent fluid through the field of view to form the N background electronic images of the field of view. The Examiner states this is disclosed in Col. 2, lines 30-47 DeForest. DeForest, however, only discloses the flowing of transparent fluid through the field of view, and does not disclose the formation of the N background electronic images of the field of view as claimed.

Thus it is respectfully submitted that claims 13 and 32 are not rendered obvious over DeForest in view of Kasdan.

<u>Claims 14 and 33</u>

On page 12 of the Final Office Action, the Examiner maintains that claims 14 and 33 are unpatentable over DeForest in view of Kasdan.

Claims 14 and 33 recite forming the background level image of the field of view by standardizing average values of the background pixel values for each of the N background electronic images before the generation of the background level pixels.

The Examiner states that this feature is disclosed in Kasdan. However, the Examiner provides no citation as to where in Kasdan this feature is allegedly disclosed. The terms "standardizing" and "standardize" could not be found in Kasdan, and as such, it is believed this feature is not disclosed in Kasdan.

Thus it is respectfully submitted that claims 14 and 33 are not rendered obvious over DeForest in view of Kasdan.

Claims 15 and 34

On pages 12-13 of the Final Office Action, the Examiner maintains that claims 15 and 34 are unpatentable over DeForest in view of Kasdan.

Claims 15 and 34 recite that the standardizing of average values of the background pixel values further comprises:

1) creating a histogram for each one of the N background electronic images, wherein each of the histograms has a peak value that corresponds to an average value of the background pixel values for one of the N background electronic images;

2) selecting a predetermined average pixel value; and

3) adjusting the background pixel values for the N background electronic images so that the histograms thereof all have peak values generally equal to the predetermined average pixel value.

The Examiner states that paragraphs [0070], [0080] and [0135] of Kasdan allegedly disclose these features. However, paragraph [0070] discloses normalizing a skeleton image used to produce line segments that characterize the size and shape of particles (see paragraph [0065]). Paragraph [0080] discloses measuring the intensity of the particle image, and doing so by isolating the particle using the mask image (of black and white pixels). Paragraph [0135] discloses using grayscale and color histograph quantiles <u>of image intensities</u> to provide additional information about the intensity variations within the particle. It is submitted that normalizing skeleton images, measuring particle image intensity, and using grayscale/color histograph quantiles <u>of the image intensities</u>, do not teach or suggest creating a histogram of each one of the N <u>background electronic images</u>, selecting a predetermined average pixel value, and <u>**adjusting**</u> the background pixel values for the <u>N background electronic images</u>, as recited in claims 15 and 34.

Thus it is respectfully submitted that claims 15 and 34 are not rendered obvious over DeForest in view of Kasdan.

<u>Claims 16 and 35</u>

On page 13 of the Final Office Action, the Examiner maintains that claims 16 and 35 are unpatentable over DeForest in view of Kasdan.

Claims 16 and 35 recite that the predetermined average pixel value is selected such that the adjusted background pixel values do not exceed a maximum pixel value thereof.

The Examiner states this is disclosed in paragraph [0132] of Kasdan. However, that paragraph discloses the use of a ratio of the maximum to average radial average values stored in the queue (as one of many Fourier Transform indicators of radial distribution of the particle - see paragraph [0083]). It is submitted that using a ratio of a maximum to average radial average values (to help determine radial distribution of the particle) does not teach or suggest selecting predetermined average pixel values so that the **<u>adjusted</u>** <u>background pixel values</u> do not exceed a maximum pixel value thereof.

Thus it is respectfully submitted that claims 16 and 35 are not rendered obvious over DeForest in view of Kasdan.

<u>Claims 17 and 36</u>

On pages 13-14 of the Final Office Action, the Examiner maintains that claims 17 and 36 are unpatentable over DeForest in view of Kasdan.

Claim 17 recites the classifying as an object pixel further includes creating a binary image of the electronic image of the field of view containing the object, wherein the binary image is formed of a plurality of binary pixels each corresponding in location to one of the image pixels, wherein each of the binary pixels is assigned to a first value if the corresponding image pixel value varies by at least a predetermined amount from the pixel value of the corresponding background level pixel, and is assigned to a second value if the corresponding image pixel value

does not vary by at least the predetermined amount from the pixel value of the corresponding background level pixel.

The Examiner states that this is disclosed in paragraph [0010] of Kasdan, which discloses a method classifying an element in an image by extracting features from the image, determining a classification class of the element, and modifying the class based upon previously determined classification class determinations. It is submitted that image feature extraction, class determination, and class determination modification, do not teach or suggest the creation of the binary image of the electronic image of the field of view are recited in claims 17 and 36.

Thus it is respectfully submitted that claims 17 and 36 are not rendered obvious over DeForest in view of Kasdan.

<u>Claims 18 and 37</u>

On page 14 of the Final Office Action, the Examiner maintains that claims 18 and 37 are unpatentable over DeForest in view of Kasdan.

Claims 18 and 37 recite that the identifying which of the object pixels correspond to an edge of the object includes re-assigning any of the binary pixels assigned with the first value to the second value that are surrounded by others of the binary pixels all originally assigned with the first value.

The Examiner states that this is disclosed paragraph [0032] of Kasdan, which discloses a method and apparatus for making decisions about the classification of individual particle images in an ensemble of images of biological particles for the purpose of identifying each individual image, and determining the number of images in each given class of particles. It is submitted that individual particle image classification to determine the number of images in each particle class does not teach or suggest which pixels correspond to the object's edge, and **<u>reassigning</u>** pixel values <u>based upon the values of surrounding pixels</u>, as recited in claims 18 and 37.

Thus it is respectfully submitted that claims 18 and 37 are not rendered obvious over DeForest in view of Kasdan.

Claims 19 and 38

On pages 14-15 of the Final Office Action, the Examiner maintains that claims 19 and 38 are unpatentable over DeForest in view of Kasdan.

Claims 19 and 38 recite that each of image pixels has a value, and the forming of the electronic image of the field of view containing the object further comprises:

1) creating a histogram for the electronic image containing the object, wherein the histogram has a peak value that corresponds to an average value of the image pixel values;

2) selecting a predetermined average pixel value; and

3) adjusting the image pixel values so that the histogram has a peak value generally equal to the predetermined average pixel value.

The Examiner states that paragraphs [0080] and [0135] of Kasdan disclose this electronic image field formation technique. However, paragraph [0080] discloses a family of particle features involving the measurement of the intensity of the particle image using the mask image to isolate the particle, and paragraph [0135] discloses using grayscale and color histograph quantiles of image intensities to provide additional information about the intensity variations within the particle. While Kasdan does contemplate creating histographs, Kasdan does not teach or suggest **adjusting** the image pixel values, let alone doing so such that the histogram has a peak value generally equal to the predetermined average pixel value as recited in claims 19 and 38.

Thus it is respectfully submitted that claims 19 and 38 are not rendered obvious over DeForest in view of Kasdan.

8. Claims Appendix

Attached herewith please find an appendix containing the claims involved in the appeal.

9. Evidence Appendix

Attached herewith please find an appendix indicating that no other evidence was entered by the Examiner or relied upon by the Applicant.

10. Related Proceedings Appendix

Attached herewith please find an appendix indicating that no decisions have been rendered by a court or the Board related to this appeal.

Conclusion

For all of these reasons, Applicant respectfully submits that the rejections based upon 35 U.S.C. 103 are in error and request the Board to affirm the patentability of the claims on appeal.

Respectfully submitted,

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APPENDIX – CLAIMS ON APPEAL

1. (Previously Presented) A method for automatically locating a boundary of an object of interest in a field of view, the method comprising:

forming an electronic image of the field of view containing the object using an imaging system, wherein the electronic image is formed of a plurality of image pixels;

identifying groups of the image pixels that represent edge segments of the object using at least one processor;

forming patches around the image pixel groups using the at least one processor, wherein each patch is dimensioned and positioned to entirely contain one of the image pixel groups; and

performing a patch merge process using the at least one processor that merges any two of the patches together that meet a predetermined proximity threshold relative to each other to form a merged patch that is dimensioned and positioned to entirely contain the two merged patches, wherein the merge process continues for any of the patches and the merged patches meeting the predetermined proximity threshold until none of the patches and the merged patches meet the predetermined proximity threshold.

2. (Previously Presented) The method of claim 1, further comprising:

associating all the edge segments contained within one of the merged patches as representing the boundary of the object using the at least one processor.

3. (Original) The method of claim 1, wherein the predetermined proximity threshold is a predetermined number of the image pixels shared by any of the patches and merged patches that overlap each other.

4. (Original) The method of claim 1, wherein the predetermined proximity threshold is a predetermined distance between any of the patches and merged patches.

5. (Original) The method of claim 4, wherein the predetermined distance is measured from boundaries of the patches and merged patches.

6. (Original) The method of claim 4, wherein the predetermined distance is measured from center portions of the patches and merged patches.

7. (Original) The method of claim 1, wherein the predetermined proximity threshold is calculated from the sizes and separation distances of the patches and merged patches.

8. (Original) The method of claim 1, wherein the forming of the patches further comprises:

dimensioning each of the patches as small as possible while still entirely containing one of the image pixel groups.

9. (Original) The method of claim 8, wherein after the dimensioning of the patches as small as possible, the forming of the patches further comprises:

expanding each of the patches by moving wall portions of the patch away from a center of the patch by a predetermined distance.

10. (Original) The method of claim 9, wherein each of the patches has a rectangular shape.

11. (Original) The method of claim 1, wherein the identifying of the groups of image pixels that represent edge segments of the object comprises:

forming a background level image of the field of view, wherein the background level image is formed of a plurality of background level pixels each corresponding in location to one of the image pixels and each having a pixel value;

classifying as an object pixel each of the image pixels having a pixel value that varies by at least a predetermined amount from the pixel value of the corresponding background level pixel; and

identifying which of the object pixels correspond to an edge of the object.

12. (Original) The method of claim 11, wherein the forming of the background level image of the field of view further comprises:

forming N background electronic images of the field of view not containing any objects of interest, wherein each of the background electronic images is formed of a plurality of background pixels each corresponding in location to one of the background level pixels and each having a pixel value, and wherein N is a positive integer; and

generating each one of the background level pixels by calculating a median value of the pixel values for the background pixels corresponding to the one background level pixel.

13. (Original) The method of claim 12, wherein the formation of the N background electronic images of the field of view includes flowing transparent fluid through the field of view.

14. (Original) The method of claim 12, wherein the forming of the background level image of the field of view further comprises:

standardizing average values of the background pixel values for each of the N background electronic images before the generation of the background level pixels.

15. (Original) The method of claim 14, wherein the standardizing average values of the background pixel values further comprises:

creating a histogram for each one of the N background electronic images, wherein each of the histograms has a peak value that corresponds to an average value of the background pixel values for one of the N background electronic images;

selecting a predetermined average pixel value; and

adjusting the background pixel values for the N background electronic images so that the histograms thereof all have peak values generally equal to the predetermined average pixel value.

16. (Original) The method of claim 15, wherein the predetermined average pixel value is selected such that the adjusted background pixel values do not exceed a maximum pixel value thereof.

17. (Original) The method of claim 11, wherein the classifying as an object pixel further includes:

creating a binary image of the electronic image of the field of view containing the object, wherein the binary image is formed of a plurality of binary pixels each corresponding in location to one of the image pixels, wherein each of the binary pixels is assigned to a first value if the corresponding image pixel value varies by at least a predetermined amount from the pixel value of the corresponding background level pixel, and is assigned to a second value if the corresponding image pixel value does not vary by at least the predetermined amount from the pixel value of the corresponding background level pixel.

18. (Original) The method of claim 17, wherein the identifying which of the object pixels correspond to an edge of the object includes:

re-assigning any of the binary pixels assigned with the first value to the second value that are surrounded by others of the binary pixels all originally assigned with the first value.

19. (Original) The method of claim 1, wherein each of image pixels has a value, and wherein the forming of the electronic image of the field of view containing the object further comprises:

creating a histogram for the electronic image containing the object, wherein the histogram has a peak value that corresponds to an average value of the image pixel values;

selecting a predetermined average pixel value; and

adjusting the image pixel values so that the histogram has a peak value generally equal to the predetermined average pixel value.

20. (Previously Presented) An apparatus for automatically locating a boundary of an object of interest in a field of view, comprising:

an imaging system for forming an electrical image of the field of view containing the object, wherein the electronic image is formed of a plurality of image pixels;

at least one processor for:

identifying groups of the image pixels that represent edge segments of the object,

forming patches around the image pixel groups, wherein each patch is dimensioned and positioned to entirely contain one of the image pixel groups, and

performing a patch merge process that merges any two of the patches together that meet a predetermined proximity threshold relative to each other to form a merged patch that is dimensioned and positioned to entirely contain the two merged patches, wherein the merge process continues for any of the patches and the merged patches meeting the predetermined proximity threshold until none of the patches and the merged patches meet the predetermined proximity threshold.

21. (Original) The apparatus of claim 20, wherein the at least one processor associates all the edge segments contained within one of the merged patches as representing the boundary of the object.

22. (Original) The apparatus of claim 20, wherein the predetermined proximity threshold is a predetermined number of the image pixels shared by any of the patches and merged patches that overlap each other.

23. (Original) The apparatus of claim 20, wherein the predetermined proximity threshold is a predetermined distance between any of the patches and merged patches.

24. (Original) The apparatus of claim 23, wherein the predetermined distance is measured from boundaries of the patches and merged patches.

25. (Original) The apparatus of claim 24, wherein the predetermined distance is measured from center portions of the patches and merged patches.

26. (Original) The apparatus of claim 20, wherein the predetermined proximity threshold is calculated from the sizes and separation distances of the patches and merged patches.

27. (Original) The apparatus of claim 20, wherein the forming of the patches by the at least one processor further comprises:

dimensioning each of the patches as small as possible while still entirely containing one of the image pixel groups.

28. (Original) The apparatus of claim 27, wherein after the dimensioning of the patches as small as possible, the forming of the patches by the at least one processor further comprises:

expanding each of the patches by moving wall portions of the patch away from a center of the patch by a predetermined distance.

29. (Original) The apparatus of claim 28, wherein each of the patches has a rectangular shape.

30. (Original) The apparatus of claim 20, wherein the groups of image pixels that represent edge segments of the object are identified by the at least one processor by:

forming a background level image of the field of view, wherein the background level image is formed of a plurality of background level pixels each corresponding in location to one of the image pixels and each having a pixel value;

classifying as an object pixel each of the image pixels having a pixel value that varies by at least a predetermined amount from the pixel value of the corresponding background level pixel; and

identifying which of the object pixels correspond to an edge of the object.

31. (Original) The apparatus of claim 30, wherein the system forms the background level image of the field of view by:

forming N background electronic images of the field of view not containing any objects of interest, wherein each of the background electronic images is formed of a plurality of background pixels each corresponding in location to one of the background level pixels and each having a pixel value, and wherein N is a positive integer; and

generating each one of the background level pixels by calculating a median value of the pixel values for the background pixels corresponding to the one background level pixel.

32. (Original) The apparatus of claim 31, wherein the system flows transparent fluid through the field of view to form the N background electronic images of the field of view.

33. (Original) The apparatus of claim 31, wherein the at least one processor forms of the background level image of the field of view by:

standardizing average values of the background pixel values for each of the N background electronic images before the generation of the background level pixels.

34. (Original) The apparatus of claim 33, wherein the at least one processor standardizes the average values of the background pixel values by:

creating a histogram for each one of the N background electronic images, wherein each of the histograms has a peak value that corresponds to an average value of the background pixel values for one of the N background electronic images;

selecting a predetermined average pixel value; and

adjusting the background pixel values for the N background electronic images so that the histograms thereof all have peak values generally equal to the predetermined average pixel value.

35. (Original) The apparatus of claim 34, wherein the at least one processor selects the predetermined average pixel value such that the adjusted background pixel values do not exceed a maximum pixel value thereof.

36. (Original) The apparatus of claim 30, wherein the at least one processor classifies the object pixels by:

creating a binary image of the electronic image of the field of view containing the object, wherein the binary image is formed of a plurality of binary pixels each corresponding in location to one of the image pixels, wherein each of the binary pixels is assigned to a first value if the corresponding image pixel value varies by at least a predetermined amount from the pixel value of the corresponding background level pixel, and is assigned to a second value if the corresponding image pixel value does not vary by at least the predetermined amount from the pixel value of the corresponding background level pixel.

37. (Original) The apparatus of claim 36, wherein the at least one processor identifies which of the object pixels correspond to an edge of the object by:

re-assigning any of the binary pixels assigned with the first value to the second value that are surrounded by others of the binary pixels all originally assigned with the first value.

38. (Original) The apparatus of claim 20, wherein each of image pixels has a value, and wherein the at least one processor forms the electronic image of the field of view containing the object further by:

creating a histogram for the electronic image containing the object, wherein the histogram has a peak value that corresponds to an average value of the image pixel values;

selecting a predetermined average pixel value; and

adjusting the image pixel values so that the histogram has a peak value generally equal to the predetermined average pixel value.

APPENDIX - EVIDENCE

None.

APPENDIX - RELATED PROCEEDINGS

None.